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Fourthly, a yellowish ruddy belt terminating sharply about 45°, in. Fifthly, an extremely narrow dark blue or bluish-green belt, Sixthly, another light zone, but of a deeper shade, and marking the commencement of the bluish-green portion. Seventhly, a lighter narrow blue belt passing through the 60th degree. Eighthly, a still deeper-shaded light zone. Ninthly, a sharply-defined, very dark blue belt, a little above the 70th degree, and encircling the pole. Of this belt about three-fourths of the whole circle can be seen, including within it the pole itself, marked by a lighter-coloured spot of about 20° diameter. Thus, if the less shaded parts, or those I have called zones, be the body of the planet, there will be distinctly traced *five belts,*—two ruddy and three of a neutral tint or bluish-green colour. I scarcely know how to apologise sufficiently for the rudeness of the drawing; but not being an artist, I have not attempted to produce an artistic effect, but only to convey a correct idea. And I have, I believe, only further to observe, that while I have not attempted to introduce the more delicate lines, something like what I have drawn undoubtedly exists on the planet, though softened down and made infinitely less *staring* than it is in the drawing.

"The ambiguous 'spot' on the south-following portion of ring *B*, close to the ball mentioned in my former letter, appears to have been the germ of the coming shadow, which, on the 15th inst. had become plain on the following portion of ring *B*, without being visible on ring *A*, and while the shadow still lingered on the preceding side. This lingering shadow had now assumed the form which the 'spot' previously spoken of presented in the early part of October, and would appear to be the 'remarkable sudden projection of the shadow of the ball' there spoken of. Whether or no this projection indicates, as has been suggested, some peculiarity of form of the edges of the rings, I certainly saw the shadow itself fairly entered on ring *B* on the following side, while it still remained visible as a fine line on the preceding side.

"I shall obtain, I doubt not, some additional testimony about the orbit of *Hyperion*, having watched him through an entire period, and obtained measures of him even at both his opposition and conjunction.

"This is a marvellous climate, a single month yielding almost three times as many observations of the satellites of *Uranus* and *Neptune* as I got all last year! The last three days, however, the weather has broken, and we have violent gusts of wind and tremendous showers of rain."

On the Appearances of Saturn. By Mr. Dawes. With a Drawing.

"The accompanying sketch of the planet *Saturn* represents the principal phenomena seen by me during the month immediately subsequent to the 19th of last September. One of Mr. Warren

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De la Rue's lithographed outlines (with some of which he kindly supplied me) has been employed, as facilitating comparison with sketches by other observers, by whom the same outline may be used. I have, however, in this sketch considerably reduced the breadth of the projection of the obscure ring on the ball, as it was originally much broader than it appeared in my telescope.

"The autumn has hitherto presented few favourable opportunities for the use of high telescopic magnifiers; but the nights of September 20th and 25th were very fine, especially the latter. Some of the notes entered on those nights I will here transcribe from my journal.

"'1852, Sept. 20. 8½-foot achromatic. The faint ring at times comes out well. There appears to me to be a *dark line* between it and the bright ring. Power 366.

"'The inner edge of the inner bright ring has, as I observed last year, a very narrow line, considerably brighter than the portion immediately exterior to it: in other words, the dark shading of the inner ring towards its interior edge does not extend quite to the edge; or, at least, it is not so dark at the edge' (illustrated by a diagram in journal). 'The dark shading has a very defined appearance, like a belt with rather sharp edges.

"'The two belts on the ball just south of the equator are pretty well defined; but the most southern is not much darker than the cap-like belt which covers the south pole.'

"'Sept. 25. 8½-foot achromatic. *Saturn;* power 460; single convex lens. Extremely distinct when the fog is not too thick to afford sufficient light. A very narrow dark line on the outer bright ring; the portion 'of the ring' exterior to this line is *less luminous* than the portion interior to it. The brightest part of the outer ring is that close to the division between it and the inner bright ring.

"'The shading on the inner bright ring is *streaky;* and it extends towards the exterior edge of the ring to within about one-fifth of its whole breadth. A dark and distinct shading, like a sharply-defined belt, is seen *near* the inner edge, but the edge itself is obviously brighter, though the brighter portion is extremely narrow.

"'The dark ring is visible, but is very faint, owing to the fog; and occasionally its exterior portion only is seen.

"'The projection of the dark ring on the ball is by no means *black;* neither is the southern edge of the dark line much, if at all, blacker than the rest of it. It appears as though the *shadow* of the faint ring were not really *black*, rendering it probable that the faint ring may be *partially transparent.* There is a striking contrast between the dark gray projection of this ring and the shadow of the ball on the bright ring, which is perfectly black.'

"This last paragraph gives the result of my endeavours to discern a difference of colour between the *projection* of the faint ring on the ball and the *shadow* which it must at that time have cast *beyond its own inner edge;* and which I expected might possibly be perceived as a *black* line distinguishable from the *gray* projection. But though the whole breadth of the dark line, made up of the

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faint ring and its shadow, was obviously broader than could belong to the projection alone, no difference could be perceived in the degree of darkness.

"On three fine nights in October, being the 18th, 19th, and 20th, I noticed a well-defined narrow belt at about 40° or 45° of south latitude on the planet. This I did not observe last year. The division of the broad belt (just south of the equator) throughout its whole length by a narrow bright line is more distinct and uniform than it usually was last year. Towards the close of last year's apparition I noticed that it had become more distinct in some portions of the planet's circumference than in others.

"The belt-like cap which covers the whole of the southern hemisphere is considerably less dark near the south pole, agreeing in this respect with the appearance last year. But when best seen, the greater part of the hemisphere appears streaky in the direction parallel to the equator.

"On the above-mentioned fine nights in October, my friend the Rev. C. Strong, who was observing with me, frequently had his attention arrested, while looking at other objects (the faint satellites especially), by the dark line on the outer ring; and remarked that it gave the impression of a division of the ring at a point a little exterior to the middle of its breadth. It is certainly remarkable that this line has continued to be visible in my telescope under fine circumstances for the last two years; while the far larger telescopes of the Harvard and Pulkova observatories, and the Starfield 20-foot reflector, have all shown the ring without even a variation of shade throughout its breadth. Is it not possible that in telescopic, as well as in microscopic observations, a certain quantity of light may be the most favourable for the discerning of extremely narrow dark lines on a luminous ground? Certainly, in my own telescope, such delicate phenomena are not most plainly seen when the planet is most brilliant; but rather, as on the exquisite night of Oct. 26, 1851, when the heavenly bodies are shorn of much of their usual splendour.

"*Wateringbury, November* 1852."

"Since the date of the observations which I communicated to the Society in the beginning of November, few opportunities have occurred of making further acquaintance with the phenomena of *Saturn*. On Nov. 16th, the planet was seen bright and clear between clouds for a very short time, during which the semi-transparency of the obscure ring was distinctly recognised with my refractor, power 323. I had that morning received from Mr. Lassell (under date 'Malta,' Nov. 9), a long and interesting account of his discovery of this fact; but expected that it would probably require the finest possible circumstances to render it distinctly visible in my telescope. I was, therefore, agreeably surprised to find it by no means very difficult to make out in a

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moderately good state of the air; and on the 18th, and especially on the 30th, it was seen satisfactorily. The edges of the ball were distinctly traceable down to the inner edge of the bright ring; the projection of the obscure ring having much the appearance of a very dark and distinctly defined belt. Such it was, doubtless, formerly supposed to be; and it is so delineated in Professor Encke's pictures of *Saturn* in the *Transactions of the Berlin Academy for* 1838.

"The dark shading which has for some time surrounded the southern pole appears to me to have formed itself into a more distinct belt than was visible in September. I believe the whole, or very nearly the whole, of this belt is seen, the middle of its breadth being about 12° from the pole, which is comparatively light. On November 30th, the whole region within 30° or 40° of the pole was noticed to have a light greenish blue tint, the tendency to green being more decided than I had before observed. The night was at times very brilliant, and *Enceladus* was distinctly seen.

"The observed semitransparency of the obscure ring has greatly strengthened an idea I have long entertained, founded on its situation and small reflective power, that it may probably be composed of water or some similar fluid; and if this notion be correct, we may reasonably imagine that its condition may be very variable; and, especially, that divisions seen in it at one time may not be recognisable at another. In estimating the degree of its transparency, it must not be overlooked that the light on the portion of the ball, which we see through it, must have passed through its substance *previously* to its reaching the planet, and thus has been *twice* transmitted through it before it comes to us.

"*Wateringbury, December* 1852."

Letter from Rev. W. R. Dawes to Mr. De La Rue.

"Saturday evening was brilliant here, but by no means sufficiently favourable for delicate observations or measurements. I attempted the latter, but with no satisfactory result. The edges of the planet were soft with the requisite power, and their flickering at the webs of the micrometer defied my attempts to get a certain observation. I then tried the double-image micrometer with little better success: two observations of the polar diameter gave 19″·13, and two of the equatoreal gave 20″·56; both too large, I have no doubt, as might be expected from the diffused state of the limbs. These obs. give

$$e = 0{\cdot}06955 = \frac{1}{14{\cdot}38}.$$

"I shall try again under better circumstances, when such are to be had.

"Thanks for the communication of your idea respecting the faint ring. I could enter upon no such niceties on Saturday. But,